SCIENCE

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SCIENCE AND ITS SERVICE TO MAN[1]

THE most striking feature of the world's history during the past hundred years is the extraordinary accession to man's knowledge of nature, the deepening of his insight into his own physical, intellectual and psychical characters and their correlations, and the recognition of the significance of environmental changes on his future earth-life. The twenty-three years of the present century show no sign of an abatement either in the rate of the extension of knowledge or in the significance of successive discoveries. The number of persons engaged on pure research, or on research into the possibilities of the application of scientific knowledge to human needs, was never greater than now. In many countries large sums have been devoted to reinforcing the means of carrying on these efforts, both as regards equipment and personnel. In not a few, men of wealth have vied with each other in creating and endowing great research laboratories, observatories and teaching institutions, and the financial means having been provided, personal devotion and qualification were not lacking.

One may well consider what this implies. The increase of human power through knowledge, the recognition of new resources in nature and of the means of utilizing them, and the enlarged ability to quicken and extend the boundaries of human relationships are such as disclose in some measure the peculiar significance of the past hundred years for future human life. The world has become indeed smaller, and touch between nation and nation speedier and greater. More clearly can it be seen that man has at his disposal very great, though practically unexplored resources; and he needs vision to see wherein opportunity lies. But increase of power carries also dangers which only fatuity can ignore. The Great War has revealed this unequivocally, and has signally shown that man's ability to wreck immensely transcends his power to ameliorate. So long as greed of wealth, national prejudices and readiness to misunderstand hold sway, so long will there be danger of this wreckage, and even upon a scale which more and more will greatly exceed the power of repair. The work of centuries may be destroyed in hours, of years in minutes. And it has, unfortunately, become more than ever a necessity to be prepared to destroy that one be not destroyed. To

[1] From the presidential address to the Australasian Association for the Advancement of Science at the New Zealand meeting.

this one may add that the exigencies of war involve the destruction of the fit: while sentiment often secures not only the survival of the unfit, but also even their reproduction. Truly, civilization may be wrecked by its own genius!

The quickening of human life and the extension of human powers call to young countries like the Dominion of New Zealand and the Commonwealth of Australia, rapidly growing into nationhood, for response in the details of their national life. For the short term of our civic existence, and judged by the average standards of the past century, we have perhaps done fairly well. That standard, however, is no longer adequate. Things are appropriately measured only by comparison; and one asks, therefore, "What, in the light of world-developments, are the scientific and other needs of Australasia to-day?" Our countries are, indeed, goodly heritages, and the right to them is effective occupation. None but the purblind can fail to note that the expansions of various populations are such that we here sorely need to survey our past development and our possible future in the light of world politics.

Considerations such as these put us upon inquiry and compel the question, "What part will Australasia play in extending and exploiting the realms of systematized knowledge, and in applying it to human needs?" I need hardly say that it is not enough merely to inherit the lore of the rest of the world; by our own contributions to the general store we must repay, or be classed among those who attempt to thrive on the genius of others.

There are, of course, among us those to whom the splendid generosities of the patrons of science call for no response of gratitude, and governments whose vision rises to that of statesmanship in providing for a better future in scientific inquiry are in their opinion but lavish and foolish. There are, however, also those who recognize that the British races must in the future—more than in the past—react to the fact that systematized knowledge is playing a rôle of new and ever-growing significance in world-affairs. Without acute national danger we can no longer ignore the need for creating for the rising generation the opportunity to become more thoroughly conscious of what is known of nature, and to become, moreover, instinct with the disposition to apply knowledge to practical ends.

It is considerations such as those expressed which will govern this matter of my address on this occasion, and I would add that the destiny of Australasia calls upon us to attend immediately to many things in which we have as yet made only a beginning—among these our equipment for research and for instruction in the whole range of the sciences. In this connection be it said that it is not, however, the material results that are the main concern. The world in which we live and the physical creations of man are but tools at our disposal, of value for our training and self-expression. Moreover, we live in a world of rivalries—here generous, there cruel and unscrupulous—and our equipment in a knowledge of nature will be a great factor in our destiny. It is not inappropriate, therefore, to consider for a moment the intrinsic character of that knowledge upon which so much depends, and at the head of which stands what has been called the "queen of the sciences," *Mathematica*, and her no less splendid sister, *Astronomia*.

I propose, then, to refer not only to the intrinsic nature of science, and to the need for creating and nurturing institutions for pure research and for inquiry into possible applications of its results to practical ends, but also to certain notable features of its recent developments.

THE NATURE OF THE HIGHER ELEMENTS OF SCIENCE

The essential elements of any science are, as it were, the basis of its higher claim upon our attention. Nevertheless, it may serve material ends. Thus mathematics and astronomy, for example, while of great value in relation to physical life—the first in the reach of its applications in physics, electricity, engineering, metallurgy, chemistry, biology, and so on, and the latter because of its services in regard to navigation, time, etc.—are of the highest value as ends in themselves, as indeed also are the higher elements of every other science. They provide a nobler discipline for the mind.

It is, moreover, a curious fact in the history of science that great discoveries have been made not by those who were thinking of practical applications, but by those whose sole aim was to reach a deeper understanding of nature. Minerva bestows her favors not on those who think they may use her to obtain a sort of Pandora's box, but on those who worship her for herself. The highest product of civilization is not the mere maintenance of man on the planet, but such maintenance as makes him a student of that vast universe of which physically he forms so utterly insignificant a part—a student, developing faculties by means of which he can appreciate beauty, magnificence, majesty, and, indeed, the whole range of things spiritually apperceived or intellectually grasped—a student capable of solving the most apparently hopeless problems.

Epoch-making conceptions flash into the mysterious world of mind as meteors in the celestial vault, and humanity is then enriched. Often revolutionizing older conceptions, their significance is in some measure realized by the prepared minds through whom they come. When a Heraclitus or a Bergson is overwhelmed with the fact that the problem of ontology

is summed up in the phrase παντα ῥδυ, a philosophy has been created. When an Archimedes bursts forth with his εὕρηκα εὕρηκα, a conception of far-reaching consequence is added to the science of physics. A Newton, seizing the idea of universal gravitation, develops the *Principia,* said by Laplace to be the greatest monument of human genius ever created. A Carnot, a Joule, a Mayer lays the foundations of the theory of heat; an Abel, reenvisaging the work of Legendre, establishes a new branch of mathematics. A Poincaré, stepping into a carriage, grasps a new mathematical truth; his technical command of mathematical reasoning enables him to establish it formally. Illustration after illustration could be given of the fact that it is to the cultivated mind that the truth appears, and so appears that its place in the world of knowledge is recognized.

The importance of a scientific conception inheres in two things: one is that it coordinates and thus systematizes our theoretical constructions of nature, making it possible to keep the manifold of phenomena within our grasp; the other, that it confers creative power in our dealing with matter. One may perhaps refer for a moment to the latter aspect.

The Creative Power of Science

It was well said by Stieglitz, of Chicago, that "it is important . . . that the public should awaken to a clear realization of what the science of chemistry really means to mankind, to the realization that its wizardry permeates the whole life of the nation as a vitalizing, protective and constructive agent." He urged that the layman should understand that chemistry is the "fundamental science in the transformation of matter." To justify this dictum fully one must, no doubt, substitute for "chemistry" a wider term. It is to chemistry coupled with mathematics, physics and technology generally that the dictum more truly applies.

We are, of course, apt to see more clearly the significance only of the realms of knowledge with which we are best acquainted. The field of acute vision is restricted, and the *fovea centralis* of the specialist eye can hardly be expected to embrace the world-picture. Thus, when with great lucidity Berthelot said that "chemistry creates its object" he spoke truly; when he added that it possesses this creative faculty in a more eminent degree than the other sciences, that assertion may be regarded as applicable rather to what may be called the "larger chemistry" than to chemistry in the more restricted sense.

The observation that "science" is creative is, however, just, if the word be understood in the sense of "systematized and coordinated knowledge." Certain branches of knowledge are but little more than a systematic record of facts—*i.e.,* they are in a broad sense "descriptive"—and their accumulation is somewhat of the nature of cataloguing, while others penetrate to the inner significance of things and result in new and fecund constructions of the world-concept. In short, one may say that science is three-phased: it is descriptive, analytic and synthetic. It is preeminently to the synthetic phase that we are most deeply indebted for creative power. Thus, one may say that the discoveries of the small shell-fishes that furnished Tyrian purple (*Ianthina, Purpura* and *Murex*) are overmatched by the chemist who synthetically made the identical but purer substance dibromindigo.[2] Nevertheless, it is well to remember that the descriptive and analytical elements are, after all, necessary means to an end.

In the broader view we see that we owe to science not merely the products of synthetic chemistry, the multitude of chemical and pharmaceutical products, the myriads of splendid dyes, the perfumes and flavoring-substances, the explosives, the viscoses, celluloids, xylonites, bakelites, etc., but the various metallurgical processes, the steels and alloys that have made practicable, and have greatly cheapened, construction, and that have created new possibilities in manufacture. Other things being equal, the people whose national equipment includes the creative laboratories, the people whose instinct is to explore the great world about them in order to know and understand its nature, the people who desire to exploit its resources, using its crude substance as raw material with which to fashion things for its requirements—these are they who must become dominant. That is in the very nature of the case. In short, not in physical toil lies the secret of national success, but in intellectual achievement in the realm of nature-knowledge and in the power attained through such achievement.

The field of exploration in nature embraces now the micro-world of the subatomic as well as the vast depths of space. Man's senses are limited, and he has been forced to extend their range by artifice.

The Need for Research

Education in the proper sense does not merely involve the acquisition of the immense stores of information now available, but also—and this is supremely important—the development of *faculty*; *i.e.,* power and facility in the use of the acquired knowledge, and the awakening of insight and inventiveness, a love for inquiry into natural phenomena and for the systematizing of knowledge. It has been fortunate for the world that individuals have devoted very large sums of money for the purposes of research—

[2] The color secreted by the shell-fish is 6:6′ dibromindigo, and is not as fine as the 5:5′ dibromindigo manufactured cheaply by the synthetic chemist in large quantities.

e.g., Prince Demidoff in Russia; Lick, Rogers, Rockefeller, Carnegie, etc., in the United States of America; the late Prince of Monaco, etc.; and Cawthron here in New Zealand—and, owing to what the war revealed, governments have begun to realize that research is an essential for national safety and progress. For example, the British Government recently granted £1,000,000 for industrial-research associations, and over £200,000 for a fuel-research station, £35,000 on a low-temperature-research station, and during last financial year expended, moreover, £204,000 on the National Physical Laboratory. Japan is establishing a national-research laboratory at a cost of over £300,000, to which the Mikado himself contributed £100,000. One business firm alone in Germany, the Badische Soda-und-Anilin Fabrik, is said to have devoted no less than £1,000,000 and to have spent seventeen years in research before a satisfactory production of artificial indigo was achieved. At the beginning of this century Germany was paying annually £600,000 for indigo. At the outbreak of war she was selling annually £2,500,000 worth of dye. In the United States of America the annual expenditure on the Department of Agriculture alone is £7,506,000; the Carnegie Institution has a revenue of £220,000; the Mellon Institute for Industrial Research cost £100,000 to build and equip, and has an annual expenditure of £77,000. Among the efforts of business firms may be mentioned the General Electric Company, which has a research staff of 150 persons, and the Eastman Kodak Company, which spends annually about £30,000. The Pennsylvania Railway Companies' laboratories cost £60,000, and employ therein 360 persons on research.

In order that research in Australasia shall be what national progress and national safety demand two things are eminently desirable: (1) The more complete equipping, staffing and endowing of our universities and technical colleges, so as to enable research work to be carried on by the teaching staffs and graduate students; (2) the development and adequate equipment and endowment of a great research institute for Australia, so that it may fulfil the functions indicated in such an act as that creating the Institute of Science and Industry. Far removed from the centers of intense intellectual and scientific life, we stand in the greater need of such assistance; and the heritage which it is our privilege to possess will, for its retention and defense, need to produce far more material wealth, and to carry a population vastly greater than is ours at the present day.

I would point out that even in apparently simple matters research is needed. The need is often by no means so self-evident as is commonly imagined, and fatuous ignorance may regard it as unnecessary. It is easy, however, to multiply illustrations to the contrary. Will you permit me to make reference, by w of an instructive example, to a very commonpla matter—the elimination of what has been call "knock," "pinking" or "detonation" in internal-co bustion engines. Independently, and as far back 1881, Bertholet and Le Chatelier found that the pro agation of flame in some mixtures of air and ce tain combustible gases, and in appropriate mixtur of oxygen with nearly all combustible gases, set up detonation wave; Mallard and Le Chatelier later a certaining that the development of this wave was a ways instantaneous, not progressive, and was mark by intense luminosity. The velocity of the wave w shown by Berthollet and Vieille to be constant, a Dixon held that during detonation the flame travel with the velocity of sound at the temperature of t burning gases. Pressures of 25 to 78 atmospher lasting an exceedingly brief period were produce these being about four times as great as the maximu "effective pressure" developed by the explosion. T intensity of such detonation increases with the degr of the compression, with temperature, with advan of the spark-timing and with the extent of carbon d posits. Even when without danger it operates to r duce the efficiency of an engine, and as a consequen researches have been directed to means of reducing eliminating it. Mathematical and physical examin tions of the question showed that during normal co bustion the pressure-differential is very small, but flame-front moving with the velocity of sound pr duces an enormous pressure-differential, heard as t "knock." Iodine and certain organic compounds, co taining selenium, tellurium, tin and lead, were fou to retard the velocity of the combustion. When mix with various fuels, benzene, which does not itself d tonate even at compressions of, say, 14 or 15 atm pheres, reduces their tendency to detonation. Agai though present in the molecular proportion of only in 50,000 of, say, kerosene-air mixture, diethyl t luride was found also to prevent detonation, and the same circumstances lead-tetraethyl in the molec lar proportion of only 1 in 215,000. One molecule diethyl telluride was equal in effect to 330 molecul of benzene. When lead-tetraethyl is mixed to the e tent of 1 volume with 1000 volumes of gasolene, pe fect smoothness of running is secured.

Now, the mere recital of the above results sho that to attack even such an apparently simple que tion as "the best means of running an internal-co bustion engine" an enormous amount of difficult r search is required, and much ingenuity is demande But when the solution is attained the economic a general advantages are very great indeed.[3]

[3] See the researches of Midgley and Boyd, of the Ge eral Motor Research Corporation, Dayton, Ohio.

I will give another instance, an unsolved problem so far—*viz.*, the production of *light without heat.* Any notable increasing of the efficiency of light-producing apparatus is self-evidently of high economic importance. The wave-lengths of visible light range between 7,600 and 4,000 Angström units (*viz.*, ten millionths of a millimeter), and ether undulations of wave-lengths outside those limits are practically valueless for lighting purposes. Moreover, even within such limits the relative intensities vary for different sources of light, being, for example, characteristically different for sunlight, the electric arc and gaslight. The problem of light-efficiency is that of insuring, in the production of radiant energy, that it shall lie wholly within the luminous limits, and, moreover, be so distributed therein that the maximum luminosity shall be obtained; this last depending, however, upon the subject—*viz.*, man of normal vision. (It is different for color-blind persons, and in general for those possessed of vision which is in any way abnormal.) Research has shown that a 4-watt carbon glow-lamp has a luminous efficiency of only 0.43 per cent., while the luminous efficiency of the firefly is no less than 99.5 per cent. The most perfect of artificial illuminants has an efficiency of only about 4 per cent. —say, one twenty-fifth of that of the firefly. This fact has inspired a large number of investigations on the nature of light produced by plants or animals; about 290 papers have been written on the subject, and the distribution of light-producing organisms in the plant and animal kingdoms has been well ascertained.[4] There appears, however, to be no order in either in the distribution of the luminescence.

Using Nutting's light-sensibility curve (1911), Coblentz, Ives, Emerson and others deduced the number of lumens[5] per watt, and found it to be 2.6 for the carbon incandescent lamp, 8.0 for the tungsten, 19.6 for the "Mazda" of type C, 42.0 for the quartz-mercury arc, and no less than 629 for the firefly (*Photinus*). Newton Harvey has recently ascertained that of the photogenic substances, luciferase and luciferin, the former is probably a complex protein, the latter a natural proteose, or at least not a protein. The luciferases and luciferins obtained from closely allied forms will interact to produce light—*e.g.*, Photuris luciferin with Pyrophorus luciferase, and *vice versa*—but unless closely allied they may produce no light whatsoever.

The remarkable fact regarding luminescence is the very small amount of substances necessary to cause a visible emission of light: for example, the impinging of a single α particle—*i.e.*, a single helium atom—upon a crystal of zinc sulphide is readily seen as a bright flash. It has been found also that 1 part of luciferase in 1,700 million parts of water will give light when luciferin is added, and similarly in regard to a soluton of luciferin when luciferase is added. This figure is *not uncertain,* for assuming that the luminous gland of *Cypridina* is wholly luciferase, it has been experimentally verified. The action involves oxidation and is easily reversible, but the luminescence itself appears to depend upon the attainment of a certain reaction velocity. It may also be noted that the greater the concentration of luciferin the longer the luminescence lasts, and the greater the concentration of luciferase the shorter it lasts. Temperature has an effect, and there is an optimum value beyond which the light decreases again. The *Photinus* firefly emits an orange and the *Photuris* a greenish-yellow light, and different colors may be obtained by using different combinations of luciferases and luciferins.

The research, so far, does not appear to have yielded any solution of the practical problem of confining the production of energy wholly within the wave-lengths, which furnish a maximum luminescence and involve no losses through heat or actinism, etc. But they are a beginning, and are systematic, and I have no doubt that the present enormous waste of energy in the production of light will be overcome, if not by a continuation of this particular study, yet by studies which exemplify the methods of such researches as those here referred to.

CREATION OF A NATIONAL APPRECIATION OF SCIENCE

As a people we lack a due appreciation of systematized knowledge. The change must come through change of our environment. Its power, however, to affect our character, mental habit, etc., if it exists at all, diminishes with our age; hence the means by which a nation is to be so taught the physical sciences that interest therein will grow with the lapse of time must be called into requisition in the youngest years of individual lives. Nearly all young children appear by nature to have that inquisitiveness which constitutes the appropriate foundation of the scientific habit, and they instinctively follow the heuristic method with but slight leading. Elementary schools whose teachers had even a smattering of scientific knowledge, and whose equipment included the means of instruction in intuitional mathematics, in physics and chemistry, and in natural history, could—even in a generation—produce a change in the mental caste of the people. Scientific nescience on the part of the teaching staff could be made good by the issue of appropriate primers, the supply of apparatus, and by giving them special lectures. National destiny will

[4] It may be mentioned that luminosity may arise from bacterial infection, and in the case of a frog which had had a large meal of fireflies the light shone through his body.

[5] The flux emitted per steradian by a uniform point source of one "international candle."

be profoundly affected by this method; for by it we can develop an instinctive disposition to rely upon the aids which science can afford in practical affairs.

The aim of a good educational system is to engender an interest in the world of mind and in its physical environment so as to ensure our being advised as to what is already known, and being endowed so as to be able to utilize the resources of nature, thus making us alert to the opportunities about us; this assuredly not in order that we may live more luxuriously, but that we may live—so to speak—more expressively.

The more advanced elements of this system will be a good series of text-books, appropriate apparatus for schools and colleges, qualified teachers, well-equipped and adequately staffed technical colleges and universities, so that the staffs shall have abundant time for research and for guiding post-graduate work. The means for carrying out such research is also sorely needed. Beyond this the scientific departments of government—*e.g.*, agriculture, etc.—would require staffs to carry on their appropriate researches, in addition to their routine duties. Finally, as before said, we need institutes for pure research, and also institutes concerned both with research and with all applications of science to industry. To these institutes persons interested might go freely for guidance, at a payment only of such fees as are needed to prevent unreasonable use of the institution. If the world be so organized as to admit of it, it were better to find hundreds of millions for such work as this than for perpetual readiness to destroy. The education and control of peoples; the means of solving the social, economic and financial problems of international life; the question of control and distribution of populations; the inauguration of a scheme of national and international life in which a spirit of service shall take the place of the spirit of merciless competition—these will need all the elements of the problems to be under review, and will call for the exercises of the most complete knowledge both of external nature and of human character. The alternative would appear to be wreckage and the spread of poisons and of disease, and these might even destroy civilization, so that knowledge, instead of having rendered noble service, would have cursed the world whose genius had called it into being.

Our hope is to see a new spirit born here. One may ask, to what end? It may be that we can not say. No one knows what lies on the knees of the gods. But there is something within the mind and heart of any great people that responds to the dream of excellence, and inflames when the vision of national destiny is before it. Our mother-land has had a great past. Is its offspring here in southern seas, illumined by "the gem-pointed cross and the blazing pomp of Orion," to rise to material, to intellectual and to moral greatness among earth's peoples? If so, the path is strenuous but glorious. All visions of ease and luxury are but opiates and lead to destruction. We shall need to gird ourselves for the task, and create for ourselves a world where our sons, knowing something of the splendid mysteries of the boundless universe, and also of our own little world, will excel in the art of using to the full the heritage our nation has given us. Then, indeed, will science have rendered noble service to the sons of Australasia.

GEORGE H. KNIBBS
INSTITUTE OF SCIENCE AND INDUSTRY,
AUSTRALIA

H. FREEMAN STECKER

IN the death of Dr. H. Freeman Stecker, ranked as one of the leading mathematicians of the world, which occurred after six months of illness, in the Mercy Hospital, Baltimore, on October 29, the Pennsylvania State College lost one of its best known scientist faculty members. He had served the college for twenty years, and in that time presented over twenty papers on mathematical subjects.

The following memorial was spread upon the minutes of the faculty organization of the School of the Liberal Arts at the Pennsylvania State College at a recent meeting:

The School of the Liberal Arts of the Pennsylvania State College, wishing to place upon its records a memorial tribute to the worth and work of Dr. Henry Freeman Stecker and to give expression to the distinct sense of professional loss which the college and school have sustained in the passing of our friend and colleague, adopts the following minute:

Dr. Henry Freeman Stecker was born at Sheboygan, Wisconsin, June 3rd, 1867, and died in the Mercy Hospital at Baltimore, October 29th, 1923. He entered the University of Wisconsin in 1889, receiving the degree of Bachelor of Science in 1893; Master of Science in 1894, and Doctor of Philosophy in 1897. He was also fellow in mathematics 1893 to 1895, and honorary fellow in 1897. During the academic year, 1900–1901, he studied at the Universities of Göttingen and Berlin. He also spent the summers of 1911 and 1912 in Paris attending lectures on mathematics, and on the latter occasion participated in the meeting at Cambridge, England, of the International Congress of Mathematicians.

His career as a teacher began in his undergraduate days, as assistant in mathematics, 1890–1895. He served at Northwestern University from 1897 to 1900, and after his year of study abroad was called to Cornell University as instructor in mathematics, where he remained until 1903. In the fall of that year, he was elected to an instructorship at the Pennsylvania State College, and by zeal and devotion to his profession rose in academic rank and preferment to a full professorship in mathematics. Dr. Stecker was a member of Sigma Xi, and of the fol-

lowing professional associations: American Mathematical Society, London Mathematical Society, Société Mathématique de France, Mathematischer Verein, and Circulo Matematica di Palermo. By his professional peers, Dr. Stecker was ranked as among the leading mathematical scholars of his time. His principal researches were in pure mathematics, geodetic lines, non-Euclidean geometry, foundations of geometry, line geometry and integral equations.

As we, his colleagues, think of Dr. Stecker, the quality uppermost in his twenty years of service at the Pennsylvania State College was the combination in a rare degree of scholar and teacher. He exacted of himself the highest standard of thoroughness and mastership, and he expected and received in a marked way like response from his students. Rigidly intolerant of sham anywhere, he has contributed his part to our Penn State spirit of honest, consistent work in the tasks of each day. A certain temperamental reserve and dignity of demeanor in his relations rendered all the more significant that deeper spirit of helpfulness and friendly cooperation which so many students and teachers have shared with him. He always stood for high standards of scholarship and moral conduct. Thoroughness, the discipline of mastering difficulties, the value of intellectual work fairly possessed him.

With all this, Dr. Stecker valued the amenities of life as well as its severe science; and his study of art, to choose one example, bore fruit in the community. It is no mere accident that his most intimate contact for many years with college athletics was with those who strove in the closest hand-to-hand encounters in boxing and wrestling. His whole career as student and teacher, even his heroic attitude in fatal illness, reveal a personality which loved the struggle of life, and which valued a man who strove with and conquered all difficulties with a brave heart and an earnest soul.

We, his colleagues of the School of the Liberal Arts, point with just pride to Dr. Stecker's twenty years of faithful service for Penn State, to his professional zeal which made him so widely known as a mathematician, and to his qualities as a man, whose thoroughness, faithfulness and honest toil are now a part of our college heritage.

It is further voted that a copy of this Memorial of the School of the Liberal Arts be transmitted with sincere expressions of deepest sympathy to Mrs. H. F. Stecker.

By the Committee,
JOSEPH H. TUDOR,
LUCRETIA VAN TUYL SIMMONS,
ERWIN W. RUNKLE,
Chairman

November 3rd, 1923

SCIENTIFIC EVENTS

THE SILLIMAN LECTURES AT YALE UNIVERSITY

IN the Silliman lectures delivered at Yale University on November 6, 7, 8, 13, 14 and 15, Niels Bohr, professor of physics at the University of Copenhagen and winner of the Nobel Prize in Physics in 1922, developed the fundamental concepts underlying the application of the quantum theory to problems of atomic structure and showed how it has been possible to account to a considerable extent for the characteristic relationships between the elements, as summarized in the periodic table.

The first lecture was devoted to a discussion of the nature of these relationships and a statement of the program of atomic physics in accounting for them. The pioneer work of Dalton, Mendeleeff and Lothar Meyer has given us the natural system of the elements, and more recent work has shown the fundamental significance of the atomic numbers for the arrangement of the elements in this system. The combination rule and the simplicity of the formulas for series point to the basic importance of spectroscopic data for the interpretation of the properties of matter. The discovery of the electron and the atomic nucleus have led to a definite picture of the constitution of the atom, and we now know that the number of electrons around the nucleus in the neutral atom is equal to the atomic number. Due to the peculiar nature of the atomic system, it is possible to distinguish between two classes of properties—the radioactive properties, which are located in the nucleus and the ordinary physical and chemical properties, which are located in the outer electronic system and depend only on the total nuclear charge or atomic number. The program of atomic physics in the future is, then, to attempt to account for the characteristic relationships between the elements by means of considerations based on pure numbers. To do this, however, it is necessary to depart from the classical concepts of mechanics and electrodynamics which are unable to account for the stability of atoms or the origin of spectra.

The character of these new concepts as pointed out in the second lecture is suggested by Planck's theory of temperature radiation and Einstein's work on specific heats and the photoelectric effect in which it is necessary to introduce the hypothesis of the emission and absorption of energy in quanta. By means of two fundamental postulates proposed by the lecturer in 1913 which are based on the ideas of the quantum theory it has been possible to account immediately for the stability of atoms and to obtain an interpretation of the combination principle which makes possible the use of spectroscopic data for the investigation of the structure of atoms. These postulates assume the existence of stationary states within the atom which are fixed by certain conditions, and the emission of radiation by transition between them. It is possible to account in this way for the spectra of hydrogen and ionized helium in all details and to obtain an understanding of the general character of the relationships between the elements.

In the third lecture the remarkable confirmation which these postulates have received from experiments on the bombardment of atoms with electrons and the emission and absorption of spectral lines was discussed in some detail.

The fourth and fifth lectures were devoted to an account of the formal development of the theory. It has been possible to obtain a general method for the fixation of the stationary states of systems with certain periodicity properties, and to establish a connection between the frequencies, intensities and polarization of spectral lines and the motion in the stationary states which in the limit corresponds to that existing in the classical theory. In this way it has been possible to account in all details for the fine-structure of the spectra of hydrogen and ionized helium as well as the effect of electric and magnetic fields on these spectra.

In the last lecture it was shown how it has been possible by means of the interpretation of spectra afforded by the theory to obtain a picture of the way in which the atoms of all the elements are built up. This picture affords an understanding of the characteristic relations between the properties of the elements, and may be said to be at least the first step in the accomplishment of the program of atomic physics.

THE EXPEDITION TO TIBET OF THE NATIONAL GEOGRAPHIC SOCIETY

JOSEPH F. ROCK, leader of the expedition to Tibet of the National Geographic Society, in a recent report to the Society, states that he has collected 914 kinds of Rhododendrons. The collection includes Rhododendrons from the richest indigo blue to orange yellow, crimson and absolutely black flowered species. It includes trees of thirty feet to prostrate plants two or three inches high. The leaves are as different as the flowers.

Mr. Rock is doing his plant collecting despite constant menace of outlaws. When he arrived at Likiang, his Yunnan province headquarters, he found 1,200 bandits encamped just north of the town, ready at any moment to sack it. He estimates there were 30,000 bandits in Yunnan alone, in August, not counting the numerous Tibetan border brigands.

Mr. Rock writes: "I am working with 23 men. Caravans are high and it is difficult to get any, no matter what one offers. The muleteers are afraid the robbers will take their mules and if the robbers don't intervene Chinese military officials may commandeer them for months without pay."

An added romance of plant hunting attaches to the shipments from this expedition because of the long, long trail they must travel to reach this country. One consignment of specimens first had to be dragged up and down lofty mountain ranges and borne through deep gorges and dense jungles for 28 days, from Nguluko to Tengyueh. Thence it went to Bhamo and from there was shipped down the Irrawaddy to begin its trans-ocean voyage.

Mr. Rock covered one unknown region, between Yunlung and Cheechuan, along the Hpi Kiang River, not yet on any map. He made his way along the Yangtze Gorge, 13,000 feet deep, and explored Mount Dyiualoko, 20,000 feet, and Haba Shan and Chiantashan, each about 18,000 feet. It is from the mountain slopes that plants are being shipped which will be suitable for planting in Glacier National Park.

The first pictures obtained of the priests of the mysterious, bejewelled Moso tribesmen were taken by Mr. Rock, showing these dignitaries in their curious dances and devil-exorcising ceremonies.

The range of plant explorations so far has covered the upper Mekong, Salwin, Yangtze and the Salwin-Irrawaddy divide. One objective of the expedition is to find a blight-resisting chestnut tree. Mr. Rock writes that he is shipping a species of the Castanopsis (related to the chestnuts) which develops trees with trunks from 4 to 6 feet in diameter. He adds: "*Pinus armandi* is a stately tree, the cones are huge and the seeds large and delicious. I shall send you a mule load."

THE EDWARD WILLIAMS MORLEY CUP

THROUGH the generosity of Alpha Chi Sigma, professional chemistry fraternity, a cup in honor of Professor E. W. Morley, emeritus professor of chemistry at Western Reserve University, who died last February, has been offered to the freshman student in chemistry who attains the highest standing for the year. The award will be based on classroom work, laboratory work and general interest in the science. The prize will be known as the "Edward Williams Morley Cup."

The letter, addressed to Professor William McPherson of the department of chemistry and dean of the Graduate School, giving the details of the award, follows:

My dear Dr. McPherson:

It is the pleasure of the Lambda Chapter of Alpha Chi Sigma to present to the department of chemistry, the Ohio State University, a scholarship cup to be awarded in accordance with the following conditions:

1. The scholarship cup shall be awarded to that student in freshman chemistry who is regarded as the leader of the class judged from his records, both in the classroom and in the laboratory and from his general interest in the science.

2. This cup shall be awarded annually at the end of the spring quarter and the recipient shall be the permanent possessor of the same.

3. This cup shall be known as the Edward Williams Morley Cup, in honor of that great American teacher and

investigator whose work was carried on largely in the State of Ohio.

4. The committee of award shall consist of the following persons:

Professor William McPherson, Professor William Lloyd Evans, and one active member selected by the Lambda chapter of Alpha Chi Sigma.

The Lambda chapter respectfully submits the foregoing and trusts that the suggestions will meet with your approval.

Very truly yours,

The Committee on a scholarship award of Alpha Chi Sigma.

FREDERICK H. MACLAREN, *chairman*,
RAYMOND S. CARTER, *president*,
GEORGE W. RUHL,
CHARLES C. CLARK.

THE NOBEL PRIZE IN PHYSICS

As was announced recently the Nobel Prize in physics for 1923 has been awarded to Dr. R. A. Millikan of the California Institute of Technology. Previous awards of the prize in physics have been as follows:

In 1901: to Professor W. C. Röntgen, Munich, for the discovery of the rays subsequently named after him.

In 1902: in two equal shares to Professor H. A. Lorentz, Leiden, and Professor P. Zeeman, Amsterdam, for researches upon the influence of magnetism on the phenomenon of radiation.

In 1903: one half to H. A. Becquerel, professor at École Polytechnique, Paris, for the discovery of spontaneous radio-activity and the other half to Professor P. Curie and Mme. Marie Curie, Paris, for their united work of investigation respecting the phenomena of radiation discovered by Professor Becquerel.

In 1904: to Lord Rayleigh, London, for his researches respecting the density of the most important gases and his discovery of argon made in connection therewith.

In 1905: to Professor P. Lenard, Kiel, for his investigations of cathode rays.

In 1906: to Professor J. J. Thomson, Cambridge, England, for his investigations, theoretical and experimental, concerning the passage of electricity through gases.

In 1907: to Professor A. A. Michelson, Chicago, for his optical instruments of precision and his spectroscopic and metrological investigations carried out therewith.

In 1908: to Professor G. Lippmann, Paris, for his method, based upon the phenomenon of interference, of photographically reproducing colors.

In 1909: one half each to G. Marconi, Engineer, London, and Professor F. Braun, Strassburg, for their contributions to the development of wireless telegraphy.

In 1910: to J. D. van der Waals, Professor Emeritus, Amsterdam, for his labors respecting the equation of state for gases and liquids.

In 1911: to Professor W. Wien, Würzburg, for his discoveries relative to the laws of heat radiation.

In 1912: to G. Dalén, Superintendent Engineer, Stockholm, for his inventions of self-acting regulators for use in conjunction with gas accumulators in providing illuminants for lighthouses and lighting-buoys.

In 1913: to Professor H. Kamerlingh Onnes, Leiden, for his researches upon the properties of matter at low temperatures, which among other results led to the production of liquid helium.

In 1914: to Professor M. von Laue, Frankfort-on-Main, for his discovery of the diffraction of Röntgen rays in crystals.

In 1915: in two equal shares to Professor W. H. Bragg, London, and W. L. Bragg, Cambridge, England, for the results of their labors in investigating crystal structures by means of Röntgen rays.

In 1916: the prize was not awarded.

The prize for 1917: was awarded in 1918 to Professor Ch. G. Barkla, Edinburgh, for his discovery of the characteristic Röntgen radiation of the chemical elements.

The prize for 1918: was awarded in 1919 to Professor M. Planck, Berlin, for the services rendered to the development of physics by his discovery of the elementary quanta.

In 1919: to Professor J. Stark, Greifswald, for his discovery of the Doppler effect with canal rays and of the decomposition of spectrum lines by electric fields.

In 1920: to Director Ch. E. Guillaume, Sèvres, in recognition of the services he has rendered to the attainment of exact measurements in physics through his discovery of anomalies in nickel steel alloys.

In 1921: to Professor Albert Einstein, of the University of Berlin, for his work in relativity.

In 1922: to Professor Niels Bohr, of the University of Copenhagen, for his work on problems of atomic structure.

THE CENTENARY OF JOSEPH LEIDY

THERE was held on Thursday, December 6, a meeting in Philadelphia to commemorate the centenary of the birth of Joseph Leidy. The following program was arranged:

(At the Academy of Natural Sciences)

Opening remarks: By the honorary chairman, DR. R. A. F. PENROSE, Jr., president of the Academy of Natural Sciences of Philadelphia.

Presentation of delegates.

General estimate of Leidy's influence upon scientific thought and development: DR. EDWARD S. MORSE, Peabody Academy of Science, Salem, Massachusetts.

Zoological work: DR. HERBERT S. JENNINGS, Johns Hopkins University.

1:30 P. M. Luncheon

Exhibition of Leidyana

2:30 P. M.

Paleontological and geological work: DR. WILLIAM B. SCOTT, Princeton University.

Botanical work: DR. WITMER STONE, The Academy of Natural Sciences of Philadelphia.

Mineralogical work: DR. FRANK W. CLARKE, United States Geological Survey.

Announcement of the Leidy Medal Foundation in the Natural Sciences

8:15 P. M.

(In the Mitchell Hall of the College of Physicians, Twenty-second above Chestnut Street)

The Joseph Leidy lecture in science: PROFESSOR HENRY FAIRFIELD OSBORN, president of the American Museum

of Natural History, New York City (under the University of Pennsylvania Foundation).

Personal recollections and appreciation of his work as an anatomist: DR. GEORGE E. DE SCHWEINITZ, University of Pennsylvania.

Leidy's influence on medical science: DR. HOBART A. HARE, Jefferson Medical College.

SCIENTIFIC NOTES AND NEWS

As has been noted in SCIENCE, the University of Paris at its opening session on November 24, conferred its honorary doctorate on Dr. W. W. Keen, of Philadelphia. In medicine the degree was also conferred on Professor Camilo Golgi, of the University of Pavia. In the sciences the degree was conferred on Sir J. J. Thomson, of the University of Cambridge; Professor Svante Arrhenius, of the University of Stockholm, and Professor Torres y Quevedo, of the University of Madrid.

A BILL providing for an annual allowance of 40,000 francs for Madame Curie was presented to the French Parliament on November 23 by the minister of public instruction in connection with the coming celebration of the twenty-fifth anniversary of the discovery of radium.

THE honorary degree of doctor of laws was conferred on Dr. J. G. Adami, vice-chancellor of the University of Liverpool, on the occasion of the installation of Lord Crawford and Balcarres, as chancellor of the University of Manchester.

A BANQUET in honor of Drs. Banting, Best and Macleod was given by the University of Toronto at Hart House, on November 26.

THE Swedish Academy of Engineering Science has awarded its gold medal to the engineers, MM. Holmstroem and Malmberg, the inventors of a contrivance called a carbometer, by means of which it is claimed to be possible to tell at any moment in the manufacture of steel the exact carbon percentage in the mass of metal.

SIR FRANK DYSON has been appointed to represent the International Astronomical Union on the International Research Council.

M. J. BRETON, member of the institute and director of the national bureau of scientific and industrial research and inventions, succeeds the late M. Violle as president of the French Commission Supérieure des Inventions.

DR. CHARLES K. MILLS, of Philadelphia, has been elected president of the American Neurological Association for the ensuing year in succession to Dr. Harvey Cushing, of the Harvard Medical School.

S. H. MCCRORY, chief of the division of agricultural engineering of the U. S. Department of Agriculture, has been elected president of the American Society of Agricultural Engineers.

DR. WARREN FRED FARAGHER has been appointed an assistant director of Mellon Institute of Industrial Research of the University of Pittsburgh. Dr. Faragher, who went to the institute in 1918 and is now in supervisory charge of its scientific investigations in petroleum technology, will begin his new work on December 1. Dr. W. A. Gruse will succeed him in his present position.

C. C. CONCANNON, chief of the Chemical Division of the Department of Commerce, returned on the S. S. "America" November 10, having been abroad for six months.

PROFESSOR JOHN L. WEBER, of Cornell University, has taken a position in the Department of Conservation and Development of the State of New Jersey.

E. R. ALEXANDER, at one time with the research and biological laboratory of E. R. Squibb, is the president of the Alexander Laboratories, just incorporated, in Kansas City, Mo. It expects to feature a product to prevent clouding of glass with moisture.

W. H. DINES retired last year from active supervision of the work on investigations of the upper air carried on at the observatory that he had established at Benson in Oxfordshire. It is now announced that the work will be transferred to the Kew Observatory.

DRS. R. NORRIS SHREVE, W. Schmidtmann and W. P. TenEyck have organized the Ammonite Company in New York for the manufacture of ammonium salts.

DR. ASHUR SHUPP, head fellow of the National Laundrymen's Association research at the Mellon Institute, has recently assumed technical charge of all of the laundries in Joliet, Illinois, under the auspices of the American Laundrymen's Association. The city laundries will constitute an experimental laboratory for the study of the laundry problem of the average city.

THE Chemical Society of Washington has elected the following officers for the ensuing year: *President,* R. S. McBride, assistant editor of *Chemical and Metallurgical Engineering*; *secretary,* J. B. Reed, Bureau of Chemistry; *treasurer,* H. W. Houghton, Hygienic Laboratory. *Counselors,* R. B. Sossman, W. Mansfield Clark, Atherton Seidell and W. W. Skinner. The remaining members of the local executive committee will be L. H. Adams, William Blum, D. K. Chestnut, C. S. Lind, F. W. Smither and E. T. Wherry.

W. D. BIGELOW, director of the National Canners' Association Laboratory, Washington, will be general chairman of the American Chemical Society convention committee for the spring meeting April 21 to 25,

1924, in Washington. W. M. Clark, of the Hygienic Laboratory, is vice-chairman. The subcommittee chairmen, who make up the general convention committee, are as follows: Atherton Seidell, finance; L. I. Shaw, registration; H. E. Howe, publicity; H. C. Fuller, hotels and transportation; R. S. McBride, entertainment; Guy Clinton, meeting rooms; L. H. Adams, excursions, and Mrs. H. E. Howe, ladies.

THE University of Alberta has received a grant of $10,000 from the Carnegie Foundation for research work by Dr. J. B. Collip, who was associated with Dr. F. G. Banting in the discovery of insulin.

PROFESSOR K. T. COMPTON, of Princeton University, addressed the New York Section of the American Chemical Society at Schenectady on November 23 on the subject, "Distribution of Mass and Charge in Molecules." The following day he spoke on "Catalytic Action of Excited Molecules" before the Colloquium of the General Electric Company.

TREAT B. JOHNSON, professor of organic chemistry in Yale University, gave a lecture on November 10 before the Chemistry Club of Mt. Holyoke College on "The chemistry of animal and plant cells."

DR. W. D. HARKINS, professor of physical chemistry at the University of Chicago, was the speaker at the opening meeting of the Purdue Section of the American Chemical Society on October 11. His subject was "The Building and Disintegration of Atoms, and the Photography of Atomic Collisions."

SIR OLIVER LODGE delivered the presidential address to the Röntgen Society on November 6 at a meeting held in the Institution of Electrical Engineers. The subject was "X-rays and the atom."

DR. ALEŠ HRDLIČKA, curator of the division of physical anthropology of the U. S. National Museum, gave an address before the Washington Academy of Sciences on October 19 on "Ancient Man in Europe."

DR. CHARLES K. CLARKE, medical director of the Canadian National Committee for Mental Hygiene, delivered the Maudsley lecture on "Psychiatry," recently, in London.

THE subjects discussed at the tenth French Congress on Hygiene, which convened at Paris on October 22, were "Hygiene in Transportation," "Bacteria from the Point of View of Biologic Purification," "Surveillance of Sources of Drinking Water" and "Garbage."

PARTS of the original chemical apparatus used by Louis Pasteur, in his experiments, are now at the University of Pennsylvania. They were brought to this country by Dr. John Frazer, dean of the Towne Scientific School, who recently returned from France, where he spent a year as exchange professor from six American universities. Through him the apparatus has been divided among the universities associated with Pennsylvania in the exchange of professorships of applied science between American and French universities.

THE memorial to the late Professor Sir German Sims Woodhead at the Cambridgeshire Tuberculosis Colony, Papworth Hall, consists of a new pathological laboratory and X-ray department. It was opened on November 22 by the Hon. Sir Arthur Stanley.

ALBERT REID LEDOUX, a past president of the American Institute of Mining and Metallurgical Engineers, died at Cornwall-on-Hudson, N. Y., October 25, in his seventy-first year.

DR. JAMES R. MCDOWELL, sixty-three years old, son-in-law and partner of the late John A. Brashear, maker of astronomical instruments, ended his life in his laboratory workshop on November 30.

THE Board of Trustees and the Corporation of the Marine Biological Laboratory at Woods Hole have passed the following minute:

D. Blakely Hoar, treasurer of the Marine Biological Laboratory, died in Boston, March 8, 1923. Mr. Hoar first came into the office of treasurer in October, 1899, and served the laboratory in this capacity for almost twenty-four years. He began his duties during a very trying period in which the laboratory was reorganized, and under circumstances that must have been for him often little short of embarrassing. But he was not a man to be put down by such conditions, and from the beginning to the end of his term of service he gave to the affairs of the laboratory untiring interest and unswerving support. In the days of small things he exerted every effort to conserve our resources, and to make clear to many of us, who from our scientific bias may have thought otherwise, the wisdom of his course. He often expressed himself with earnest passion, yet always with a saving sense of humor and a generous patience. In him the laboratory loses a devoted and a loyal servant, and many of its members a valued friend.

THE honorary presidency of the Gorgas Memorial Institute of Tropical and Preventive Medicine has been accepted by President Coolidge, in a letter which was read before a meeting of the board of directors of the organization at the Pan-American Union Building, Washington, D. C., on November 13. The President's letter said in part:

The organization stands for a world movement to bring the lands and climates of the tropical world into their fullest productivity and service to humanity. This is certain to be one of the great problems of the coming generations, increasingly insistent as the population of the temperate zones shall increase. One of the great accomplishments of the last half century has been the development of sanitary and medical procedures by which the tropics have been made available for the habitation of peoples acclimated to the temperate areas. General Gorgas will always be remembered as foremost among

those who have labored intelligently and effectively in this cause, and I am glad to be associated with an organization which proposes to project that great service into the future.

The Gorgas Memorial Institute which will be established at Panama City will have an endowment fund of $5,000,000 raised by popular subscription.

THE Federation of American Societies of Experimental Biology will meet at St. Louis from December 27 to 29.

THE International Union of Physics, which includes representatives from France, Belgium, Denmark, Japan, Poland and the United States, will hold its first general assembly at Paris from December 28 to 31.

AN exposition organized in celebration of the fiftieth anniversary of the French Physical Society will be held in Paris during the first weeks of December.

WE learn from the *Journal* of the American Medical Association that a group of northern Ohio residents have organized to establish a model health community and nerve rehabilitation center near Cleveland. The charter, which has been taken out under the name of the Psychiatric Foundation of the Western Reserve, will be on the order of the MacLean Institute, Boston; the Friends Hospital, Philadelphia, and the Sheppard and Pratt Hospital, near Baltimore. It is designed as a rest colony and research center. Laboratory equipment will be installed for the investigation of all phases of practical psychology, and the cause and treatment of nervous and mental ailments. The staff will comprise an experienced psychiatrist and a corps of physicians, nurses and aids. The institution will be heavily endowed and will be operated on a cost basis.

WE learn from *Nature* that Professor J. J. R. Macleod, professor of physiology in the University of Toronto, who was recently awarded the Cameron prize for 1923, delivered two lectures in the University of Edinburgh on October 16 and 17, respectively, on the nature of control of the metabolism of carbohydrates in the animal body. He dealt with the discovery of insulin and its value in the investigation, not only of diabetes, but also of other problems of metabolism. The Cameron prize was founded in 1878, and is awarded to an investigator who in the course of the five years immediately preceding has made an important addition to practical therapeutics.

THE Mayo Foundation, in cooperation with the local chapter of Sigma Xi and the universities of Wisconsin, Minnesota and Nebraska, and Washington University (St. Louis), has arranged a course of lectures to be given this autumn and winter on various phases of heredity. The first lecture was given October 29 at the University of Wisconsin by William Ernest Castle, professor of zoology at Harvard University, Boston, on "Heredity—the general problem and its historical setting." Professor Castle delivered the same lecture at Rochester on October 30, at Minneapolis on October 31, at Omaha on November 1, and at St. Louis on November 2. Other lectures were as follows: November 6, Professor John A. Detlefsen, Sc.D., of the Wistar Institute, Philadelphia, "The inheritance of acquired characteristics"; November 19, Miss Maud Slye, University of Chicago, "Heredity in relation to cancer," and December 4, Professor Harry Gideon Wells, University of Chicago, "Human cancer from the standpoint of heredity."

ARRANGEMENTS are being made for a series of "symposia" at Harvard—meetings at which two or three members of the Harvard Faculty will discuss one scientific subject from different points of view. The first of these symposia was held on November 6. The subject was "The origin of life." The speakers and their topics were: (a) "Life throughout the universe," Harlow Shapley, Paine professor of practical astronomy and director of the Harvard College Observatory; (b) "Early phases of terrestrial life," Edward C. Jeffrey, professor of plant morphology; (c) "Life and spirit," Kirsopp Lake, Winn professor of ecclesiastical history. Early in December the second symposium will be held. The general title will be "Sound," and it is expected that the speakers will be Associate Professor Frederick A. Saunders, of the department of physics; Archibald T. Davison, associate professor of music, college organist and choir master; and Professor George H. Parker, of the department of zoology and director of the zoological laboratory.

THE Special Board for Biology and Geology of the University of Cambridge have recommended that £100 per annum of the Worts Traveling Bachelors Fund should be subscribed to the Zoological Station at Naples. During the war and for some time afterwards the station passed under the control of the Italians, who appointed Professor Monticelli as president; but it has now reverted to the management of Dr. Rinehardt Dohrn, son of the founder of the station, who is now director, and is assisted by a committee thoroughly representative of Italian science and Italian affairs. The connection of Cambridge with the Naples laboratory has lasted unbroken for half a century.

EDUCATIONAL AND UNIVERSITY NOTES

CORNELL University announces the receipt of a gift of $200,000 from an anonymous donor for the purpose of establishing an endowment fund, the pro-

ceeds of which are to be devoted to research work in the department of pediatrics in Cornell University Medical College in New York City.

THE trustees of Rutgers College, on October 12, received an anonymous gift of $150,000 for an addition to the Vorhees Library building.

IN the will of the late William S. Richardson, who died October 6, the sum of $75,000 is left to the Massachusetts Homeopathic Hospital, Boston, on condition it keeps pace with the general advancement of medicine and surgery for the next five years. If the hospital is not progressive the fund will go equally to Harvard University and the Sulgrave Institution, which institutions are to receive the remainder of the $210,000 estate.

IT is announced that the formal opening of the Atlanta Graduate School of Physicians and Surgeons will take place April 9, 1924. Dr. William Perrin Nicolson is dean, Dr. Garnett W. Quillian, vice-dean, and Dr. Michael Hoke, president of the faculty.

EDGAR ALLEN, Ph.D., Washington University, St. Louis, has been appointed professor of anatomy at the University of Missouri School of Medicine, Columbia.

GEORGE R. GAGE has been appointed an instructor in botany in the department of biology of DePauw University for the present year.

DR. OLE N. DEWEERDT has been appointed head of the department of psychology at Beloit College.

DR. IRVING S. BARKSDALE, Richmond, has been elected associate professor of physiology at the Medical College of South Carolina at Charleston.

DISCUSSION AND CORRESPONDENCE

SODIRO HERBARIUM

WHILE at Quito I had the opportunity of examining the herbarium left by the well-known botanist, Sodiro, who brought together the only important collection of plants in Ecuador. The collection is housed at the Colegio de San Gabriel, a Jesuit institution, where it is appreciated and is being well kept. My examination was confined to the grasses, but I assume from the size and general appearance of the collection that all families are well represented.

The original Sodiro specimens are, for the most part, mounted and well labeled. Nearly all are accompanied in the herbarium by one to several duplicates, these being sometimes mounted but usually unmounted, lying in folders with the labeled specimen.

I was permitted to select a series of duplicates for the U. S. National Herbarium, for which I was charged ten dollars per hundred. Apparently the college is willing and anxious to dispose of the duplicates at the price mentioned. Those interested in Andean botany would do well to supply themselves. I am informed that the college has a collection of about 400 birds that it wishes to sell. Of the condition of these I know nothing. It will be of interest to botanists to know that the college has on hand extra copies of many of the publications of Sodiro which it wishes to sell. Father Mille, through whose kindness I was enabled to examine the herbarium, and who is the only Ecuadorean botanist interested in collecting, is adding to the Sodiro Herbarium.

All communications should be addressed to Father Luis Mille, Apertada 266, Quito, Ecuador.

A. S. HITCHCOCK
U. S. DEPARTMENT OF AGRICULTURE,
GUAYAQUIL, ECUADOR

A CLASS EXPERIMENT TO SHOW THE BEHAVIOR OF HEMOGLOBIN TOWARD VARIOUS GASES

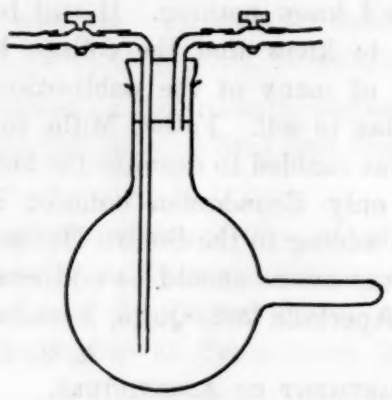
Two years ago I introduced into the laboratory work of my class in biochemistry at the University of Virginia a simple experiment which has proved so successful in making real to students the behavior of hemoglobin under exposure to various gases that I am passing it on to others. The points of special value in the experiment are: (1) avoidance of frothing of the laked blood by bubbling gases through it; (2) convenience in observation of the spectrum; and (3) ease of estimating the approximate and relative times required for the completion of the various reactions observed.

Into the side of a 250 cc balloon flask is fused a 10 x 80 mm test-tube; the size of test-tube is chosen so that it will fit into the holder of a direct vision hand spectroscope. The mouth of the flask is closed by a 2-hole stopper; glass inlet and outlet tubes, shown in the diagram, permit the passage of any gas through the flask. It is thus possible to spread a solution in a thin layer over the sides of the flask during aeration and to return it immediately to the test-tube for spectroscopic examination.

Laked blood is diluted with water until, when examined spectroscopically in a small test tube, two distinct and fairly deep absorption bands of oxyhemoglobin are seen. This oxyhemoglobin solution is then poured into the dry spectroscopic glass flask and the stopper made tight. Stop-cocks are provided on each piece of rubber tubing to insure exclusion of air during spectroscopic examinations.

A current of nitrogen, hydrogen or carbon dioxid is then passed through the flask while the laked blood is kept spread in thin layers on the walls by gentle rotation, and the reduction of the oxyhemoglobin to

hemoglobin observed both with the naked eye and spectroscopically. It is usually complete in a few (three to five) minutes with a moderately strong aerating current.



The immediate reverse change to oxyhemoglobin upon blowing through a current of air is then observed spectroscopically.

Carbon monoxid or illuminating gas is then passed through the flask and the very rapid change to carbonyl-hemoglobin observed both by the cherry red color on naked eye inspection and also spectroscopically. It goes without saying that this can be performed, starting either with hemoglobin or with oxyhemoglobin.

The change from carbonyl-hemoglobin to hemoglobin is then observed by the passage of a current of nitrogen, hydrogen or carbon dioxid. Usually it takes 15 or 20 minutes to effect the complete disappearance of the two carbonyl hemoglobin bands as compared with the three to five minutes required for the disappearance of the two oxyhemoglobin bands under identical conditions, thus visualizing to the student the difference in velocity of dissociation of oxyhemoglobin and carbonyl-hemoglobin.

That the combination of the hemoglobin with carbon monoxid has not changed its power of combination with oxygen is then readily demonstrated.

It is also instructive to require the student to explain why a current of nitrogen or other indifferent gas changes both oxyhemoglobin and carbonyl-hemoglobin to hemoglobin, while ammonium sulphide or Stokes reagent has this effect only with oxyhemoglobin.

The apparatus also obviously lends itself to other instructive demonstrations. When the aeration flask and test-tube are made strong enough and pressure tubing is employed the air pump may be used instead of the current of indifferent gas. The behavior of hemoglobin towards other gases, active and indifferent, as well as the influence of physico-chemical conditions in the solvent may similarly be studied.

These experiments bring home to the student that in all cases the common factor responsible for breaking up the combination of hemoglobin with active gases is the reduction of the partial pressure of the active gas in the solution. Practical hygienic applications to the treatment of cases of gas poisoning are obvious.

THEODORE HOUGH

PHYSIOLOGICAL LABORATORY,
UNIVERSITY OF VIRGINIA

THE TRANSMISSION OF NEMATODE RESISTANCE IN THE PEACH

IN the spring of 1919 the writer, at that time connected with the Georgia Experiment Station, planted peach seedlings grown from pits obtained from three sources in root-knot nematode infested soil at the Georgia Experiment Station.

One lot of pits was obtained from a tree on a farm near Tallahassee, Florida, a second lot was obtained near Cordele, Georgia, and the third lot was made up of seed from several trees growing at the experiment station.

During the summer it was observed that the seedlings from the Florida pits were growing more vigorously than those from the two lots of Georgia pits.

Examination of these trees in the fall of 1919 showed that the Florida seedlings were practically free from root-knots; while the seedlings from both lots of Georgia pits were heavily infested, thus accounting for their less vigorous growth.

The resistant peach seedlings were reset in nematode infested soil where they continued to make a vigorous growth during the season of 1920. Examination in the fall showed that these seedlings retained their resistance to the root-knot nematode as stated by the writer in the annual report of the Georgia Experiment Station.

Since the peach is not readily propagated except by seed nematode, resistance will have to be seed transmitted if much practical use is to be made of this resistance, so tests were planned to determine this point.

These resistant peach seedlings produced their first crop of fruit in the summer of 1921, and seed from these were tested in root-knot nematode infested soil in the summer of 1922. Pits from Belle of Georgia fruits were planted in the same soil as checks.

In the fall of 1922 the seedlings were dug and examined and it was found that the trees from Georgia Belle pits were heavily infested with root-knots, while the second generation Florida seedlings were free from root-knots. This indicates that this Florida seedling peach is resistant to the root-knot nematode and that the factor for resistance is seed transmitted.

Since July 1, 1922, the writer, as a member of the Tennessee Experiment Station, has continued this

investigation with a view to practical application, but it seems desirable to present this progress report to show the possibilities of root-knot nematode control through resistant fruit stocks.

J. A. McCLINTOCK
UNIVERSITY OF TENNESSEE
AGRICULTURAL EXPERIMENT STATION

QUOTATIONS

THE MASSACHUSETTS COLLEGE OF PHARMACY

OUTCOME of an association founded by Dr. Ephraim Eliot of Harvard one hundred years ago, the Massachusetts College of Pharmacy on November 15 observed the centennial of that organization, which is, in a sense, the centennial of the college. It was a day of many speeches. Running through them all was expression of the idea that the occupation of the pharmacist, whether or not it may properly be called a profession, has been raised to professional dignity and importance. Perhaps it is well for the public to be reminded of this fact in these days when many a drug store contains articles of vast variety in nowise connected with drugs and remedies. It is easy to forget that somewhere in such establishment are the men who have been scientifically trained in the compounding of remedies for human ills.

Significance of the anniversary as bearing upon the problems of youth was also indicated. Payson Smith, commissioner of education, spoke of the boys who are drifting from job to job trying to find their proper place in life. The vocational school, whether it be a college of pharmacy or whether it be devoted to instruction in other occupation, makes appeal to many a boy who might otherwise become one of the drifters, and introduces him to a life of greater usefulness.

The Massachusetts College of Pharmacy is fortunate in the possession of the building given it by the late George Robert White, whose great gift to Boston has made possible the creation of the proposed health units which were described by Mayor Curley in his remarks at yesterday's observance. These health centers in crowded sections of a great city suggest the opportunity which the pharmacist has in common with other citizens to devote time and energy to the public service. But in a larger sense the pharmacists as a body are in the public service, inasmuch as they stand with the physician in the battle with disease and the maintenance of the public health. It is therefore, cause for general satisfaction that institutions such as our own college of pharmacy are to be found in the land, giving their students the technical training which they need and emphasizing the ideals which should guide them in their chosen occupation.—*Boston Evening Transcript.*

SCIENTIFIC BOOKS

Publications of the Astronomical Observatory of the University of Michigan, Volume 3. Published by the Observatory, Ann Arbor, 1923. 270 pages, 16 plates.

THIS volume is a compilation of recent investigations of the Detroit Observatory, chiefly in the field of stellar spectroscopy. The opening papers are continuations of a series by R. H. Curtiss on "Studies of Class B stellar spectra containing emission lines." It is shown that the widths of the hydrogen emission lines in any one of these stars bears a nearly linear relation to the wave lengths and that the lines so plotted for the stars intersect not far from wave length 3270 A.; so that, if the width of one emission line is measured, those of others in the same spectrum may be calculated quite accurately.

In the second paper Professor Curtiss discusses, among other features of Class Bp stars, their evolutionary status. These stars may be said to stand apart from normal helium stars not merely as having more extensive atmospheres, but also because of the excitation of their atmospheres to luminosity. They may have developed uniquely along one of the current evolutionary sequences which he reviews; or, as seems to him more probable, they differ from other Class B stars by virture of a stimulus received by encounters with diffuse nebulosities and differing only in degree from that which produces the novae.

One of these stars, Kappa Draconis, is found to be a spectroscopic binary of a peculiar type. Broad emission and underlying absorption lines oscillate in a period of nine days; but the narrow absorption lines which divide the hydrogen emission, including also the narrow K line of calcium, do not share this oscillation. The orbit of the Class Bp star Sigma Cygni is calculated by F. Henroteau. Another paper by the same author deals with radial velocities of Boss's antapex group of stars. The preferential motion of this group is found in substantial accordance with Boss's conclusions.

It is interesting to find, in a paper by C. C. Kiess, a complete confirmation of the remarkable behavior of Alpha Canum Venaticorum, to which Ludendorff and Belopolsky called attention ten years ago. Two groups of faint lines, attributed by some writers to the rare earth elements, vary reciprocally in intensity, and certain of them yield variable velocities of the same period as the intensity variations; while the majority of the lines, including the more prominent ones, are apparently invariable in both respects. Moreover, maximum intensity occurs coincidently with maximum velocity of approach. It seems to the reviewer

to be obvious, especially when Guthnick's light curves for this star are recalled, that we have here an extraordinary case of Cepheid variation and one that should be taken into account in theories of this perplexing type of variable star. Doubtless this is not the only example of its kind.

Among the sixteen papers in this volume two others, at least, are especially noteworthy. Under the title: "New silicon lines in Class B stars," W. C. Rufus, R. A. Sawyer and R. F. Paton identify many lines of hitherto unknown origin in the spectra of helium stars. These disclosures originated in recent laboratory investigations with the vacuum spark, in the course of which the known number of silicon lines was increased fivefold. In the closing paper, R. H. Curtiss and D. B. McLaughlin discuss the results of their spectroscopic observations of comets, especially Delavan's comet of 1913. An advance in this field is marked by their success in deriving accurate radial velocities from the reflected solar spectrum of the comet.

Excellent enlargements of stellar spectra illustrate the volume, among them a beautiful series of Nova Geminorum II by Professor Curtiss and a very valuable sequence of typical spectra by Dr. Rufus.

ROBERT H. BAKER

UNIVERSITY OF ILLINOIS

SPECIAL ARTICLES

EVIDENCE OF A SPARK LINE IN THE LITHIUM SPECTRUM[1]

EXPERIMENTS in this laboratory[2] have shown that the thermionic discharge in gas at low pressure is an effective means of exciting spark lines and that these lines are relatively strong at potentials only slightly greater than the critical voltage. The method has been applied to lithium vapor in an attempt to discover spark lines in this element. The design of discharge tube has been described elsewhere.[3]

Electrons from a tungsten cathode are accelerated by the potential applied between it and a nearby anode and the larger part of the electron path is in an equipotential region. The discharge is concentrated by the magnetic field (about 200 ampere turns) of a copper helix surrounding the tube. In this case the helix served at the same time as a heater to vaporize the lithium. Temperatures between 500° C. and 600° C. were used. The discharge was photographed with a large Hilger quartz spectograph.

Spectra were obtained at applied potentials ranging from 8 to 200 volts. The only noticeable change in the spectrum (apart from lines of known impurities) was the appearance near 50 volts of a line λ 2934.15 $\pm$ .1 I. A. This line appeared in one very long exposure at 45 volts. It was very faint at 55 and strong at 60 and above. The photographic density of the line at 100 volts was less than that of the fifth line of the principal series and greater than the sixth. Between 100 and 200 volts the intensity was only slightly increased.

The lithium used was not exceptionally pure. Sodium and hydrogen were always present. No likely impurity of the observed wave length is listed in Kayser's table of principal lines. A faint spark line of sodium is listed by Foote, Meggers and Mohler (*l. c.*) at λ 2934.4, but the absence of other stronger lines on the lithium plates excludes the possibility that the new line belongs to sodium. In one tube the lithium was contaminated with magnesium. The magnesium spark lines λ 2936.496 and λ 2928.625 were faintly visible on either side of the new line and served as convenient comparison standards. The plates were not, however, suitable for measurements of high precision.

To excite the spark spectrum of lithium the valence electron and one of the K electrons must be removed from the atom. Removal of the valence electron alone requires 5.3 volts and the potential for removal of the K electron alone we will call V_k. Removal of both by a single collision will require a potential greater than the sum of the two. The spark spectra of other alkalies are visible at the second ionization potential of the normal atom under conditions of current density comparable with those used with lithium, but are greatly enhanced at a potential four or five volts greater than this. This indicates that $V_k = 50$ volts with a probable error of at least 5 volts.

Holtsmark[4] and McLennan and Clark[5] have published critical potentials for the excitation of K radiation from solid lithium oxide and lithium. The former gives 52.8, the latter 42.4 volts. As the experiment is very difficult the results may be questioned without discrediting the ability of these physicists. However, the value here estimated for V_k is in agreement with Holtsmark's results.

The spark spectrum of lithium must resemble the arc spectrum of helium, but will have series terms from two to four times as great. Few lines will fall within the range of the quartz spectrograph. The line λ 2934 may correspond to the strong helium

[1] Published by permission of the Director of the Bureau of Standards of the U. S. Department of Commerce.

[2] Foote, Meggers and Mohler, "Enhanced spectrum of Mg.", *Phil. Mag.*, 42, p. 1002, 1921; "Enhanced spectra of Na and K," *Astro. Phys. J.*, 55, p. 145, 1922.

[3] Mohler and Ruark, "J O S A and R. S. I.", 7, p. 819, 1923.

[4] Holtsmark, *Phys. Zeits.*, 24, p. 225, 1923.

[5] McLennan and Clark, *Proc.* Roy. Soc. A., 102, p. 389, 1923.

doublet $2s - 2p_{1,2}$, λλ 10829.1, 30.3. Until we have a satisfactory theory of the helium arc spectrum speculation as to the new line will be useless.

An interesting feature of the spectrum of the thermionic discharge in lithium is the unusual development of the subordinate series. Eleven lines of the sharp series and 16 of the diffuse were plainly seen on one of the plates. Only six and seven, respectively, are listed in tables of series lines. The principal series was recorded to the tenth line.

F. L. MOHLER

BUREAU OF STANDARDS

ON THE DISPERSITY OF SILVER HALIDES IN RELATION TO THEIR PHOTOGRAPHIC BEHAVIOR

IN an article appearing in SCIENCE for October 26, 1923, under the above heading, Dr. Frank E. Germann and Mr. Malcolm Hylan query a conclusion reached by Wightman, Trivelli and Sheppard, on the relation of grain size and photographic sensitivity. Their first questioning of the conclusion that the sensitivity increases with the grain size is based on an example quoted in "Monographs on the theory of photography," No. 1, p. 104, where comparison of two emulsions showed that the one having grains one third the linear dimensions was more than 19 times as fast and that the same was true of individual grains in the same emulsion. The explanation of this discrepancy has been amply provided subsequently by discoveries concerning the function of sensitive specks in the silver halide grains.[1]

They quote further the conclusion of Koch and DuPrel that "it is not possible to formulate any definite relationship between the grain size and sensitivity with the information at present available," to which it may be replied that very much more data are now available than were at hand at the time that Koch and DuPrel made their statement.

With regard to the theoretical considerations they advance, we find ourselves in considerable disagreement with them. They conclude, on the nuclear theory (without specifying what they mean by the nuclear theory), that the speed depends on the *number of grains affected* without reference, therefore, to the size of the grains. It can be seen from the work of Svedberg and others that this argument is entirely in contradiction with the present nuclear theory, since the number of specks or nuclei increase with the size of grain and, therefore, the chance of a grain being made developable by light increases with its size. As we have pointed out in other papers,[2] this result is independent of whether the continuous wave theory or the quantum theory of the constitution of light be adopted. The decision between these two theories must be reached on other grounds. Consequently, we can not agree that "theoretically the smaller grained emulsion should be the more sensitive," but rather the reverse. We may point out in this connection that the writers have not defined exactly what they mean by "sensitivity." Speed, in the usual photographic significance of the term, depends on density measurements, that is, on the number and size of the developed grains conjointly. Sensitivity can be determined microscopically from counts of grains independently of density measurements and the sensitivity of grains of a given size can therefore be specified in a manner independent of such density measurements.

It does not appear necessary, therefore, to discuss their explanation of a discrepancy between experimental results and those theoretically expected, which discrepancy does not in our opinion exist.

We shall await publication of their experiments on removing adsorbed halide from silver bromide grains with interest, but prefer to postpone discussion of this until we have their fuller data.

E. P. WIGHTMAN
A. P. H. TRIVELLI
S. E. SHEPPARD

ROCHESTER, N. Y.

[1] See papers of Svedberg, *Phot. Journ.*, 62, 186, 316 (1923); Toy, *Phil. Mag.*, 44, 352 (1923); *ibid.*, 45, 715 (1923); Silberstein, *Phil. Mag.*, 44, 252, 955 (1923); *ibid.*, 45, 1062 (1923); S. E. Sheppard and E. P. Wightman on "The theory of photographic sensitivity," SCIENCE, 1923, pp. 89–91.

THE AMERICAN CHEMICAL SOCIETY

(Continued)

DIVISION OF ORGANIC CHEMISTRY

Frank C. Whitmore, *chairman*
R. R. Renshaw, *secretary*

The uses of acetylene in synthesis: J. A. NIEUWLAND. The evolution of acetylene in organic syntheses began with the introduction of catalytic agents to effect reactions. Some of the following important types of catalytic syntheses were discussed: A—The halogenation reactions, typified by (a) catalytic $AlCl_3$ reactions; (b) catalytic $SbCl_3$ reactions. B—Catalysis with mercury salts, as (a) acetaldehyde, glacial acetic acid and acetone; (b) paraldehyde synthesis; (c) synthesis of ethylidine diacetate, acetic anhydride, formaldehyde and methyl acetate; (d) synthesis of acetals and cyclic acetals; (e) synthesis of acetylene with aryl hydrocarbons; (f) synthesis of acetylene with phenols (bakelite), and the dinaphthylols; (g) synthesis with reacting substances in solution, aldehyde blue, and green, acridine and xanthene dyes. Quinaldine, indole, cinnamic aldehyde, nitro cinnamic aldehyde and indigo. C—Syntheses with Cu_2Cl_2, as (a) divinyl acetylene, and derivatives (HCHO); (b) quinaldine and quinoline de-

[2] *J. Franklin Inst.*, 194, 485 (1922); *J. Phys. Chem.*, 27, 141 (1923).

rivatives. General remarks on the possibilities of future progress in synthesis with C_2H_2 were made.

Synthesis of a new bicyclic nitrogen ring. Isogranatanine derivatives. Preparation of an isomer of homococaine: S. M. McELVAIN and ROGER ADAMS. A method for the preparation of a derivative of a new bicyclic nucleus containing a nitrogen atom common to both rings has been developed. The new nucleus has been called isogranatanine because it is isomeric with granatanine. The particular derivative especially investigated was ethyl benzoyl isogranatoline carboxylate, prepared by reduction of the ethyl granatonine carboxylate and subsequent benzoylation. The ethyl benzoyl isogranatoline carboxylate hydrochloride is isomeric with homococaine hydrochloride, and is a powerful local anesthetic.

Recent developments in the chemistry of arsphenamine: WALTER G. CHRISTIANSEN. Arsphenamine, *i.e.*, salvarsan, as prepared by the customary process, *i.e.*, reduction of 3-nitro-4-hydroxyphenylarsonic acid with sodium hydrosulfite is not a pure substance, but contains at least three impurities—two sulfur compounds and one oxide. The amounts in which these impurities are present and the toxicity of the product are dependent upon the experimental conditions existing during the reduction. By the use of various modifications of these reactions, these impurities may be largely eliminated, but since a product which is satisfactory for clinical use can be secured by the above reaction, there is no necessity of abandoning this process. The colloidal properties of arsphenamine have an important bearing on the toxicity of this substance.

The electronic conception of valence and the heats of combustion of organic compounds: MORRIS S. KHARASCH. The paper concerns itself with the application of the notions developed in a previous paper to the explanation of a number of properties of organic compounds. Considered in this light the study of the heats of combustion furnishes us with a very powerful tool for the determination of the electronic structure of organic compounds. The heats of combustion of some 275 organic compounds calculated upon this basis agree very well with the values that have been determined experimentally.

Petroleum as a chemical raw material: B. T. BROOKS. Petroleum is sometimes referred to as a rich mixture of raw materials which should yield a wide variety of chemical derivatives comparable with the large number of substances which have been prepared or manufactured from coal tar. The problem of isolating pure substances from petroleum is, however, quite different and for the most part yet unsolved. Our present chemical knowledge of the hydrocarbons in petroleum enables us to make a certain limited survey of what might be expected in the way of a chemical development of this raw material. In this discussion the problem is considered more from the standpoint of research in organic chemistry than from the standpoint of the more or less well-known problems of the petroleum industry proper. The present discussion is limited more to an effort to indicate what organic chemists can reasonably expect to do with this raw material rather than to discuss any improvements or extensions in the application of petroleum products such as are now manufactured and utilized in the industries.

Wednesday—9.30 A. M.

SYMPOSIUM ON SYNTHETIC METHODS

The alkylation of primary amines with aluminum ethoxide to give pure secondary amines: W. A. LAZIER and HOMER ADKINS. Both aromatic and aliphatic amines (aniline, p-toluidine, n-pentyl amine, n-butyl amine) have been alkylated with aluminum ethoxide, isopropoxide, normal butoxide and isobutoxide at temperatures of from 275°–350° to give secondary amines entirely uncontaminated with tertiary amines. The reaction of aluminum ethoxide and aniline has been most thoroughly investigated. A 90 per cent. yield of mono ethyl aniline has been obtained at 350° in a sealed tube, 10 per cent. of the aniline remaining unchanged.

Methylation by means of dimethyl sulfate: H. F. LEWIS. Mass relationships have been studied in the methylations of the phenolic hydroxyl groups. Attempts have been made to develop a procedure for the utilization of the second methyl group in dimethyl sulfate. To a certain extent this has been accomplished.

Ethylation of aniline by means of diethyl sulfate: A. R. CADE. In the experimental work which forms the basis for this paper the reaction between diethyl sulfate and aniline has been studied. Varying mixtures of aniline, monoethylaniline and diethylaniline are prepared by varying the molecular ratio of the aniline and of the diethyl sulfate originally used in the reaction. The effect of the time and temperature of heating the reaction mixture has been studied. A method for preparing a high grade diethyl aniline, or a mixture of mono- and diethyl aniline free from unused aniline are recommended as a result of the data obtained.

The preparation of the simple olefine bromides: C. E. BOORD. The bromine addition products of ethylene, propylene, butylene and amylene are easily and rapidly prepared in quantity by generating the olefine by the contact process and passing the gas counter-current to bromine or a solution of bromine in carbon tetrachloride in a special absorbing device. The products are purified by fractional distillation or if necessary fractional distillation under diminished pressure. Since the product is in contact with bromine for only a short length of time substitution is reduced to a minimum.

Modification of the Sandmyer synthesis of nitriles: H. T. CLARKE and R. R. READ. The standard method for the preparation of nitriles from aromatic amines suffers from the disadvantage that poisonous gases are evolved at two stages in the process, namely, cyanogen during the formation of the cuprous cyanide and hydrocyanic acid during the reaction of this with the acid diazonium solution. It has been found possible to avoid both of these difficulties; firstly, by preparing the cuprous cyanide solution by dissolving cuprous chloride in sodium cyanide and, secondly, by neutralizing the diazonium solution before adding it to the cyanide. The intermediate addition products formed under these conditions are extremely unstable, rapidly evolving nitrogen below 0°, and decomposing almost explosively unless the mixture is well agitated, preferably in presence of a diluent such as benzene. The yields fully equal those obtained by the standard procedure.

Methods of manipulating liquid ammonia solutions: E. C. FRANKLIN.

A new method of preparing alkyl halides: JAMES F. NORRIS. Primary alcohols are readily converted into the corresponding halides by heating the alcohol with concentrated hydrochloric acid and anhydrous zinc chloride. Proportions found to give the best results were one mol. of alcohol, two of hydrogen chloride as concentrated hydrochloric acid and two of anhydrous zinc chloride. The yields varied from 60 to 80 per cent.

Simplification of the Gattermann synthesis of hydroxy aldehydes: ROGER ADAMS and I. M. LEVINE. The Gattermann synthesis for the preparation of hydroxy aldehydes by the reaction of phenols, anhydrous hydrogen cyanide and dry hydrogen chloride in dry ether, sometimes with the addition of anhydrous zinc chloride, gives excellent yields of products. The method is not as frequently used as might be expected owing to the necessity of handling anhydrous hydrogen cyanide. The synthesis has been modified in such a way that this has been avoided. In place of the hydrogen cyanide, zinc cyanide is used, which is converted into anhydrous zinc chloride and anhydrous hydrogen cyanide in the reaction mixture. The zinc cyanide is readily prepared by treating an aqueous solution of sodium cyanide with magnesium chloride in order to precipitate the carbonate and hydroxide present, filtering and adding an alcoholic solution of zinc chloride. The precipitated zinc cyanide is filtered and dried. Experiments have shown that in several types of reactions anhydrous hydrogen cyanide has been previously employed, zinc cyanide may be substituted.

A new method for the synthesis of esters of chloroximino acids. Evidence of the existence of aliphatic diazonium salts: GLENN S. SKINNER. In attempting to obtain evidence of the existence of aliphatic diazonium salts by working at low temperatures, using esters of glycocoll in the presence of a large excess of hydrochloric acid, the esters of chloroximino acetic acid were found to be the chief product. These compounds by treatment with sodium carbonate give good yields of the corresponding nitrile oxides or their polymers. A comparatively small amount of the esters of chloracetic acid is also formed. The possibility that the chloracetic ester is first formed and then oxidized to the chloroximino ester has been eliminated by the fact that it remains unchanged when subjected to similar conditions. A second explanation of the reaction is that the diazo ester is first formed and this then reacts with the elements of nitrosyl chloride from the excess hydrochloric and nitrous acids present. However, the diazo ester was shown to give none of the substance when treated with nitrosyl chloride. A study of the molecular weight of the nitrile oxide in four different solvents shows that it is an equilibrium mixture of the monomolecular form and the dimolecular form the so-called furoxandicarboxylic ester. The yield of the chloroximino compounds varied from 50 to 80 per cent. of the theoretical. The reaction should be formulated as follows: $ClN_2CH_2CO_2R +$

$$HNO_2 \rightarrow ClN_2C(N=O)(H)CO_2R \rightarrow Cl-C(=NOH)-CO_2R.$$

Condensation reaction: FRED W. UPSON. Certain points relative to carrying out the following reactions were discussed: (1) Reactions involving benzyl cyanide; (2) reactions between aniline and chlorohydrins; (3) addition of HCN to sugars.

Sodium amalgam as a reducing agent for oximes and aldehydes: L. CHAS. RAIFORD and E. P. CLARK. When sodium amalgam is prepared from pure mercury in accordance with the directions of the authors (J. Am. Chem. Soc., 45, 1740 [1923]) and used as specified, it is found to be a suitable agent for the reduction of certain oximes to the corresponding amines. Contrary to the results of Goldschmidt and Ernst (Ber., 23, 2740 [1890]), who found that only a poor yield of amine could be obtained by reduction of salicylaldoxime with sodium amalgam, although they tried several modifications of the method, we obtained a yield of 96 per cent. When salicyaldehyde was employed under similar conditions, with the exception that the liquid was kept faintly acid with acetic acid during the reaction, a yield of over 90 per cent. of the corresponding alcohol saligenin was obtained. The highest yield we have found reported in any other case is 63 per cent. Several other examples are being studied.

Tertiary butyl alcohol: ROLAND R. READ and F. A. PRISLEY. Isobutylene, prepared by the catalytic dehydration of the isobutyl alcohol, is passed into a light petroleum distillate kept at a temperature below —10°. The saturated solution is agitated vigorously with 50 per cent. sulfuric acid, the temperature being allowed to rise slowly to that of the room. The aqueous layer is separated and neutralized. Tertiary butyl alcohol is then distilled out and dried.

The use of phenyl-hydrazine for the preparation of some derivatives of benzo-pyrrol: E. C. KENDALL and A. E. OSTERBERG. The use of phenyl-hydrazine for the preparation of indol derivatives has long been known. Reduced benzo-pyrrol derivatives can be prepared by treating phenyl-hydrazones of cyclo-hexanone and its derivatives. To prepare members of the alpha-oxy-benzo-pyrrol series, the derivative of cyclo-hexanone must contain a side chain of two carbons terminating in a carboxyl adjacent to the ketone group, such as ortho-cyclo-hexanone acetic acid. If the hydrazone of ortho-cyclo-hexanone acetic acid is treated with acids, it will lose ammonia, producing a double bond within the ring, and will form the phenyl derivative of the open ring form of alpha-oxy-benzo-pyrrol. Derivatives in which a side chain is attached to the beta carbon of the benzo-pyrrol nucleus have also been prepared. The properties of these compounds depending upon the position occupied by the double bond will be discussed.

The oxidation of sucrose, glucose and fructose: C. D. LOOKER and W. L. EVANS. Sucrose and an equivalent mixture of equal parts of glucose and fructose were oxidized by means of potassium permanganate at 50°, 75° and 100° C. In neutral solutions, carbon dioxide and acetic acid were obtained upon complete oxidation. In potassium hydroxide solutions of varying concentrations at 50° and 75°, oxalic acid was also obtained and increased in quantity up to about 0.1 N alkalinity and

then decreased, but at 100° the amount of oxalic acid increased again beyond 1.0 N alkalinity. As oxalic acid increased, carbon dioxide always decreased proportionally. Acetic acid was nearly constant under all conditions.

Derivatives of the beta-chloro-vinyl arsines, II: W. LEE LEWIS and H. W. STIEGLER. In addition to previously reported derivatives, the following have been isolated in the pure state: beta-chloro-vinyl arsine sulphide; bis-beta-chloro-vinyl arsine sulphocyanate; tris-beta-chloro-vinyl methyl arsonium iodide; double salt of tris-beta-chloro-vinyl methyl arsonium iodide and mercuric iodide; double salts of tris-beta-chloro-vinyl arsine and silver nitrate with (a) 1 mole arsine and 1 mole $AgNO_3$ and (b) 2 moles arsine and 1 mole $AgNo_3$; double salt of tris-beta-chloro-vinyl methyl arsonium iodide and phenyl mercuric iodide.

Arsenoacetic acid and its polyarsenide: C. SHATTUCK PALMER. Hypophosphorous acid reduction of arsonoacetic acid, $H_2O_3As.CH_2.COOH$, leads to arsenoacetic acid, $HOOC.CH_2As = AsCH_2COOH$, yellow needles, which decompose above 200° but do not melt. The product is practically insoluble in water and common organic solvents, but readily soluble in pyridine and dilute aqueous alkali hydroxides and carbonates. Simultaneous reduction of one mol. As_2O_3 and two mols arsonoacetic acid gives the polyarsenide, $HOOC.CH_2.As = As — As = As.CH_2.COOH$, bright vermillion microcrystalline powder, resembling the simple arseno compound in solubilities and behavior on heating. The sodium salts of arsenoacetic acid and its polyarsenide are the first known water-soluble aliphatic derivatives of the arseno and polyarseno linkages.

The action of beta-chloro-ethyl chloroformate on amino-arylarsonic acids, and subsequent formation of arsonated N-arylamino alcohols. Preliminary Paper: CLIFF S. HAMILTON. The interaction of beta-chloro-ethyl chloroformate, prepared from ethylene chlorohydrin and phosgene, and amino-arylarsonic acids results in the formation of arsenated beta-chloro-ethyl carbanilates. These in turn give arsonated oxazolidones on treatment with alkali. The arsonated oxazolidones on further treatment with alkali yield, in some cases at least, arsonated N-arylamino alcohols.

The addition of mercuric salts to α, β-unsaturated ketones: EDMUND B. MIDDLETON. Unsaturated ketones reacted with alcoholic solutions of mercuric acetate. Ketones with one double bond like benzalacetophenone gave products whose composition is expressed by ketone plus —HgOCOCH$_3$ plus —OR, while dibenzalacetone gave products with two —HgOCOCH$_3$ and two —OR. They are α-acetoxymercuri-β-alkoxy ketones. If mercuric halides were used instead of mercuric acetate colored compounds consisting of one molecule each of ketone and mercuric halide resulted. The white products obtained with mercuric acetate gave reactions similar to those obtained from olefines: decomposition with acids, etc. With bromine, the mercury was replaced and α-bromo-β-alkoxy ketones resulted, for example, α-bromo-β-methoxy-β-phenyl propiophenone from benzalacetophenone. This lost HBr with alkali and the resulting unsaturated ketone reacted further with mercuric acetate to give diacetoxymercuri-dibenzoyl methane. On acidification, dibenzoyl methane was obtained.

The direct mercuration of benzine, and the preparation of mercury diphenyl: J. LEWIS MAYNARD. Direct mercuration offers the simplest method of obtaining derivatives of the type C_6H_5HgX. However, the method has heretofore been impracticable because of the very low yield of desired product. Since acetic acid formed in the reaction $C_6H_6 + Hg(OAc)_2 = C_6H_5HgOAc + HOAc$ apparently prevents more complete forward reaction, HgO was added to neutralize the HOAc as rapidly as it formed. Based on the quantity of $Hg(OAc)_2$ used, the theoretical yield of C_6H_5HgOAc was obtained by refluxing the three reactants for 55 hours. $Hg(C_6H_5)_2$ may be obtained from C_6H_5HgOAc by heating it under pressure to 140° with alkaline sodium stannite solution.

Unsymmetrical mercuri-organic derivatives and the nature of valences of mercury: MORRIS S. KHARASCH and MILDRED W. GRAFFLIN. The number of unsymmetrical mercuri-organic derivatives, of the type $RHgR_1$, recorded in the literature is limited to a few instances. The compounds are also claimed to be extraordinarily unstable and to decompose into two symmetrical molecules: $2\ R_1HgR \rightarrow R_1HgR_1 + RHgR$. The writers have evolved a method of preparing unsymmetrical mercury derivatives. Those prepared thus far are stable even at 200° and do not decompose into two symmetrical molecules. The decomposition of these molecules with acids should throw considerable light upon the nature of linkage of the mercury and the carbon atoms of the respective molecules.

The chemistry of furfural. The preparation of the furfural analog of benzoflavine or dimethyldiamino-furyl-acridine hydrochloride: S. A. MAHOOD and C. R. HARRIS. Furfural can be substituted for benzaldehyde to give condensation products with amines analogous to the derivatives of tri-phenyl-methane. When meta-phenylene-diamine is used tetraamino-ditolyl-furylmethane is obtained. This yields, with hydrochloric acid under pressure, dihydro-diamino-dimethyl-furyl-acridine hydrochloride which on oxidation gives a new dye, the furfural analog of benzoflavine. It is typical acridine dye; gives to silk, wool and unmordated cotton a rich brown color and in fastness and stability is indistinguishable from its analog. Contrary to the work of O. Fisher but in accordance with that of Renshaw and Naylor, the substitution of the furyl for the phenyl group in dyes does not appear to render them less stable.

The polymorphic forms and thermotropic properties of Schiff's bases derived from 3-methoxy 4-hydroxy-5 iodo benzaldehyde: RAYMOND M. HANN. A review of the previous work on the effects of actinic light, trituration and heat upon the color changes of the parahydroxy anils. Discussion of the theories for explaining these physical changes bringing in mention of the Hantzach Werner theory of molecular rearrangement, the molecular aggregation hypothesis and the possibility of stereoisomeric forms. Finally the effect of the introduction of a negative radical in the benzylidene group upon the polymorphic and thermotropic properties.

The ketenic decomposition of ketones: CHARLES D. HURD. Ketene was produced, not only from acetone, but also from methyl ethyl ketone and diethyl ketone when their vapors were passed through an electrically heated platinum coil in a partial vacuum. In addition, methyl ketene was obtained in small yields from methyl ethyl ketone and from diethyl ketone. High temperatures, apparently, decompose methyl ketene with the resultant production of ketene. Acetone and methyl ethyl ketone formed very small amounts of liquid condensation products. Much of the diethyl ketone, however, was changed to higher boiling material.

The addition of nitrogen trichloride to unsaturated hydrocarbons. II: G. H. COLEMAN and ELIZABETH PICKERING. Nitrogen trichloride adds to β-n-Amylene, α-n-amylene, and cyclohexene with the formation of C-chloro-N-dichloroamines. By the action of conc. HCl these amines are changed to C-mono-chloromines. The C-chloroamine obtained from β-N-amylene was reduced by sodium amalgam to the corresponding amyl amine.

Nitrophenols and nitrodiphenyl ethers: F. W. SULLIVAN, JR. 2, 4, 2′, 4′ tetranitrodiphenyl ether was obtained in 90 per cent. yield by the reaction between 2, 4 dinitrochlorbenzol and the potassium salt of 2, 4 dinitrophenol. On nitration with $NaNO_3$ in 50 per cent. fuming sulfuric acid, this yields 2, 4, 6, 2′, 4′ pentanitrodiphenyl ether, which melts at 205°. The constitution of this substance was proved because of its identity with the product obtained by the reaction between picryl chloride and the potassium salt of 2, 4 dinitrophenol. A small amount of a hexanitro compound melting at 258° is also obtained at the same time. This is believed to be the hitherto unknown anhydride of picric acid, but its constitution has not yet been proved. In connection with this work improved methods for the preparation of o-nitrophenol and 2, 6 dinitrophenol have been developed.

Derivatives of para-nitrobenzaldehyde: C. G. KING and ALEXANDER LOWY. p-Nitrobenzaldehyde was condensed with the following aromatic amines, forming "Schiff bases": o-nitroaniline, 2,6-dibromoaniline, 2,4,6-tribromoaniline, o-bromoaniline, m-bromoaniline, 3-bromo-4-toluidine, and p-xylidine. The first three would not condense satisfactorily in alcohol or glacial acetic acid, but did condense on direct fusion. Reduction of the nitro group on condensation products of the above type yielded unstable products. Dimolecular condensations were carried out with p-nitrobenzaldehyde and the following compounds: phenol (tetra-brominated and acetylated), resorcinol (dibrominated), thymol (dibrominated and benzoylated), o-nitrophenol and o-methyl anisol. In each case, bromination increased the depth of color. Oxidation of the phenolic products gave compounds analogous to the aurine dyes.

The electromotive force of organic compounds. II. The unsaturated hydrocarbon groups. S. B. ORENSON and D. J. BROWN. The observed potentials at 25°C. against the normal calomel electrode were $+0.09 - 0.03 \log (C_2H_4)(H+)$ for ethylene. Ethylene bromide and glycol seemed to have little or no effect on the observed potentials.

The composition of whale oil: C. H. MILLIGAN, C. A. KNUTH and A. S. RICHARDSON. The composition of whale oil has been studied by fractionally distilling the methyl esters of the solid, liquid and mixed fatty acids of the raw oil and also the methyl esters of the fatty acids of the hydrogenated oil. Whale oil, like other marine animal oils, contains a complicated mixture of fatty acids of carbon content varying from 14 to 22, probably with a small amount of C_{24} acids. The highly unsaturated acids are chiefly of 20 and 22 carbon content.

A contribution to our knowledge of orthoquinones: LEONARD T. CAPELL and C. E. BOORD. The substituted catechols were prepared by the action of potassium persulfate on para substituted phenols. The catechols were oxidized by the Willstatter method using dry silver oxide. The methyl, ethyl, terbutyl, teramyl and monochloro substituted derivative of o-benzoquinones were prepared. The absorption spectra of the green, red and yellow forms of these quinones were photographed and compared. All forms show the same absorption in dilute solution.

Basis for the physiological activity of certain onium compounds, III. Rates of Hydrolysis of esters and ethers of choline and of its analogs. Preliminary communication: R. R. RENSHAW and N. BACON. Dale has advanced the hypothesis that the extraordinary activity of acetyl choline and the evanescence of its action when compared with its ether and other esters may be due to the rapid hydrolysis of the former. The rates of hydrolysis of acetyl choline, the methyl ether of formocholine, acetyl formocholine and the acetyl derivative of the sulfur analog of formocholine have been studied at the temperature and hydrogen potential of blood. The preliminary experiment would seem to negative the suggestion of Dale.

The influence of high temperature on the decomposition of anthraquinone: H. F. LEWIS and SHERMAN SHAFFER. The action of dry heat and steam at atmospheric and elevated pressures has shown that there is a definite point beyond which anthraquinone begins to decompose rather rapidly. These upper temperature limits of stability approach 450 degrees with an air pressure of 35 pounds, 400 degrees with a steam pressure of 35 pounds, and 375 degrees with a pressure of 30 pounds of oxygen. A temperature of 500 degrees decomposes anthraquinone at such a rate that at the end of eight hours approximately 80 per cent. of the original anthraquinone has been decomposed. A study has been made of the decomposition products which shows that there are at least two new substances produced—one extremely stable and the other very unstable. The stable substance being of the nature of hydroxy-anthraquinone and the unstable substance indicating the condensation of two or more molecules of anthraquinone.

The action of acetylene on phenols: HERMAN WENZKE and J. A. NIEUWLAND. Acetylene in the presence of sulfuric acid and a mercury salt readily condenses with phenols to form ethylidene compounds. As in the case of ordinary phenol the position of linkage is usually para whenever that position is unoccupied. The tendency to form an aromatic acetal is slight, β-naphthol being the only compound tried that reacts in that way. The re-

action with acetylene continues even after the theoretical quantity of 1 mol. of acetylene to 2 mols of phenol has been absorbed. A tarry, resinous body is formed when an excess of phenol is absorbed. The presence of negative groups in the benzene ring as NO_2, SO_2OH, COOH prevented the reaction with acetylene. The phenol ethers, anisol and phenetol do not react with acetylene. Most of the condensation products polymerized on heating or on long standing to form an insoluble body.

Synthesis of aspartic acid: GLENN S. SKINNER and HARRY E. CARSWELL. A study of the conditions affecting the yield of aspartic acid has been made in its production from maleic and fumaric acids by the action of ammonia. The reaction has been carried out at temperatures of 100°, 109°, 117°, 125° and 137° for periods of time ranging from five to more than a hundred hours. The temperature range 110°–125° is most satisfactory. The optimum pH value for the precipitation of the aspartic acid was found to be 4.5. The conditions employed by Emil Fischer and by Engel were found to be unsatisfactory and it has been found possible to increase the yield to 70 per cent. of the theoretical. The melting point of the pure acid is 215°–217° in a closed tube.

The oxidation of sugars: FRED W. UPSON and M. H. POWER. Glucose has been oxidized by air in the presence of saturated lime water. The oxidation is slower than in the presence of more concentrated alkali as used by Nef but the products are qualitatively the same. Formic, d-arabonic, d-erythonic, glycollic, oxalic and carbonic acids are among the oxidation products. Experiments on the speed of oxidation of glucose and fructose in the presence of six equivalents of NaOH have been carried out. Glucose and fructose oxidize at practically the same rate. The rate is no faster with oxygen under two atmospheres pressure than it is with air at atmospheric pressure.

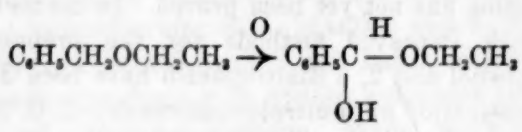
The oxidation of maltose in neutral and alkaline potassium permanganate solutions: W. L. EVANS and M. L. WOLFROM. Maltose is oxidized by neutral permanganate solutions at 50° to acetic and carbonic acids. In alkaline solutions oxalic acid is also an oxidation product in addition to acetic and carbonic acids. The oxalic acid production reaches a maximum at about 0.1 N alkali, while the carbon dioxide reaches a minimum at about this point. At higher alkalinities the oxalic acid diminishes in amount to a small degree while the carbon dioxide increases.

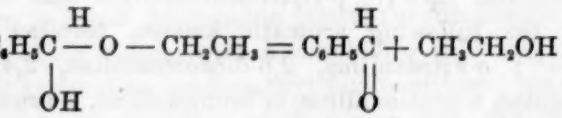
The oxidation of propylene glycol in potassium permanganate solutions: E. C. HYTREE and W. L. EVANS. When propylene glycol is oxidized in potassium permanganate solution at 0°, lactic acid is obtained as one of the oxidation products in addition to acetic and carbonic acids. Evidence was also obtained for the presence of lactide in the reaction mixture. From a consideration of the possible oxidation mechanisms it is highly probable that lactic aldehyde is an intermediate compound in the formation of lactic acid under these experimental conditions.

The relation between molecular structure and odor in tri-substituted benzenes. I. Derivatives of para-methoxy-acetophenone. M. T. BOGERT and L. P. CURTIN. Trisubstituted benzenes carrying three osmophores in 1:3:4 arrangement are not always odorous, even when sufficiently volatile. Although 4-methoxy-acetophenone itself is a perfume substance, the introduction of the osophores NO_2, NH_2, N_3 or CN, in position 3, results in odorless products. Certain new hypotheses are advanced concerning steric hindrance. The following new compounds are described:—the 3-sulfo, 3-amino, 3-acetamino, 3-p-nitrobenzal amino, 3-iodo, 3-iodochloride, 3-iodoso and 3-cyano derivatives of 4-methoxy-acetophenone; and from the 3-amino, the corresponding diazo perbromide, azido, diazoamino and aminoazó derivatives; also the 3-iodoso-4-hydroxy-acetophenone.

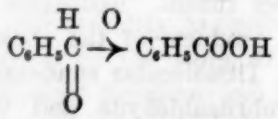
The synthesis of new rose alcohols of citronellol-rhodinol type: M. T. BOGERT and E. M. SLOCUM. Iodohydrin acetates were condensed with sodio acetoacetic ester at 0°, the products hydrolyzed to the keto alcohols, and the latter subjected to Barbier-Grignard reactions, the primary-tertiary glycols first formed losing water with production of the desired olefin alcohols. Dimethyl-hexenols,—heptenols,—octenols, etc., were thus obtained from acetopropanol, acetobutanol, etc. Some of these products have fine rose-like odor. The odor of others is more of cedar oil type. Various new intermediates were synthesized in the course of the investigation, and some old methods of preparation were improved so as to give greatly increased yields.

The decomposition of benzyl ethyl ether in air: RALPH C. HUSTON. Benzyl ethyl ether appears to be less stable in air than the simple dialkyl ethers, the aryl alkyl ethers or the diaryl ethers. Its decomposition apparently takes place according to the following scheme:





The benzaldehyde formed is then further oxidized to benzoic acid:



These changes take place when the pure ether (B. P. 185°) is allowed to stand for several weeks in an ordinary ground glass stoppered bottle. A small amount of the ether when placed on a watch glass and allowed to stand over night deposits crystals of benzoic acid. Benzyl alcohol is not oxidized under similar conditions. Since benzyl alcohol and acetaldehyde were not found in the decomposition products, it appears the CH_2 group between the oxygen and phenyl group is the main point of attack. The effect of other alkyl groups on the stability of the CH_2 between oxygen and phenyl group is being studied.

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